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## BLADE HOLDER WITH CUTTING FORCE ADJUSTMENT

INDEPENDENT OF STROKE

*Background of the Invention*

~~Description~~

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5 The invention relates to a blade holder for cutting machines with a blade head, which is supported at a lowering device, and with an advancing device for the circular blade secured at the blade head, whereby the advancing device, for movement of the circular blade between a cutting position and a ready position comprises a compressed-air actuated advancing piston rod with an advancing

10 piston guided in a chamber of the housing of the blade head whereby the advancing piston rod is pretensioned by a pressure spring into the ready position of the circular blade.

A blade holder with the aforementioned features is disclosed in DE 41 14 059 A1. The blade head which supports the circular

15 blade is positioned at the end of a lowering piston rod with which the circular blade is lowered into the cutting plane, respectively, lifted therefrom. The advancing device arranged within the blade head provides for an adjustment of the circular blade transverse to the axis of the lowering piston into a contact position at a lower blade,

20 respectively, lifts the circular blade away from the lower blade when no cutting action is performed.

For performing these movements, the advancing device comprises an advancing piston which is actuated by compressed air in the direction of the cutting position of the circular blade, while, for return of the circular blade from the cutting position, a pressure spring is provided that loads the advancing piston rod into the ready position for the circular blade. Accordingly, the cutting force between the circular blade and the corresponding lower blade is predetermined, respectively, adjustable by the pressing force in the direction of the cutting position of the circular blade provided by the pneumatically activated advancing piston which overcomes the effect of the pretensioned pressure spring.

Such a design of the blade holder has the disadvantage that the aforementioned kind of cutting force control is not sufficiently precise because of the employed pressure spring (having own in tolerances and non-constant spring characteristic lines). When in the frame of such a cutting machine a plurality of such blade holders is used, a pneumatic drive pressure adjusted identically for each blade holder and the advancing piston does not accordingly produce an identical cutting force because, as a function of the respectively lifting position of the circular blade, respectively, of the lifting piston rod and as a function of the spring tolerances and the

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spring characteristic line of the respective pressure spring, a spring force of a different magnitude counteracts the pneumatic drive pressure acting in the direction of the cutting position of the circular blade.

5 From DE 26 57 792 A1 a blade holder is known in which by eliminating a pressure spring for returning the advancing piston rod into its ready position, the movement of the advancing position rod into the cutting position as well as into the ready position is realized by a pneumatic system. Such an embodiment, however, is  
10 complicated with respect to controlling the respective pneumatic drive for the two movement directions.

15 It is an object of the invention to improve for a blade holder of the aforementioned kind, including a pressure spring for effecting the return of the advancing piston rod, the precision of the cutting force control.

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~~The solution to this object results, including advantageous  
embodiments and developments of the invention, from the contents  
of the claims, which follow this description.~~

20 The invention is based on the basic idea that, for overcoming the force of the pressure spring acting onto the advancing piston rod during the cutting operation, a pressing device is arranged that

loads the pressure spring in the direction of the cutting position of the circular blade and is decoupled from the advancing piston rod.

5 The invention has the advantage that with the additionally provided pressing device the effect of the pressure spring loading the advancing piston rod on the cutting force control is eliminated because after compression of the pressure spring, optionally to the completely compressed "block" state, the cutting force is determined exclusively by the adjustable pressing force that can be determined by pressure loading of the advancing piston. Accordingly, the  
10 cutting force control is especially independent of the respective stroke of the advancing piston rod and can be performed more precisely. When the pressing device is without pressure, the pressure spring, which is optionally compressed completely to a "block", is released and thus will return the circular blade, by loading  
15 of the advancing piston rod, into the ready position.

According to one embodiment of the invention, it is suggested that the pressing device is a slide engaging the pressure spring arranged between the advancing device and the circular blade. For actuation of the slide, a pneumatic air drive is provided.  
20 According to one embodiment of the invention, it is suggested that the slide embraces externally the blade head housing and is guided

on the exterior side of the blade head housing. In this context, it is suggested that the slide engages with a projection, extending radially into the blade head housing, engages the pressure spring which is arranged in a recess of the blade head housing.

5           In a constructively different embodiment, the slide is embodied as a piston, arranged in the blade head housing and loaded by a pneumatic drive, whereby the pressure spring supported at the inner side of the blade head housing is connected to the piston and the piston pretensions the advancing piston rod  
10           into the ready position of the circular blade. This constructive solution has the advantage that the blade head housing is embodied of a unitary construction and that the pressing device with slide or piston is arranged in the interior of the blade head housing.

          According to one embodiment of the invention, it is  
15           suggested that the advancing piston is embodied as a diaphragm which is seated on the advancing piston rod and is positioned with its circumference in the chamber so as to seal relative to the blade head housing. This has the advantage that based on the lack of loading of the advancing piston rod by the pressure spring,  
20           diaphragm can be designed more simply because the operating pressures for adjusting the pressing or cutting force are reduced.

The diaphragm, according to one embodiment of the invention, can also be a rolling diaphragm.

5 The cutting force control can be improved in an advantageous manner by providing a pressure sensor between the diaphragm and the circular blade for measuring the cutting force acting at the circular blade. According to different embodiments of the invention, this arrangement can be such that the pressure sensor is arranged between the diaphragm and either the axially positioned wall of the chamber at the pressure side or at a  
10 projection provided at the advancing piston rod. In both instances, the pressure sensor can measure at the diaphragm the force acting against the resistance of the circular blade resting on the lower blade.

15 According to a further embodiment of the invention, it is suggested that between the diaphragm and the blade support a damping member is arranged. The arrangement of such a damping member, loads caused by the circular blade at the pressure sensor and/or at the diaphragm, for example, in the form of impacts resulting from imbalanced circular blades, can be  
20 compensated and their effects onto the cutting force control can be minimized. According to alternative embodiments of the invention,

the damping member can be positioned between the diaphragm and the projection of the advancing piston rod or between the pressure sensor and the projection. A further embodiment may be such that the advancing piston rod is divided transverse to its longitudinal axis and that the damping member is inserted between the thus formed rod portions. The damping element itself can be embodied as a shaped body of elastic material or can be embodied as a spring.

### *Brief Description of the Drawings*

In the drawing embodiments of the invention are represented which will be described in the following. It is shown in:

Fig. 1 a blade holder in longitudinal section;

Fig. 2 the blade holder of Fig. 1 in another embodiment;

Fig. 3 the advancing piston rod with damping element *of the embodiment shown in Figure 1*

in an individual representation.

### *Description of Preferred Embodiments*

In the represented blade holder 10 at the end of its lowering piston rod 12 of a lowering device 11, that is not part of the invention and is disclosed in the prior art according to DE 38 41 576 C2, a blade head 13 is provided in which an advancing piston rod 14 is moveably arranged transverse to the axis of the lowering piston rod 12. At the correlated end of the feed piston rod 14, a blade holder *holding member*

15 is arranged in which the circular blade 16 is secured. The circular blade 16 is surrounded by a hand protector 17 in the ready position shown in the drawing.

5 As not shown in further detail, the circular blade 16 can be moved to the left of the drawing by displacement of the advancing piston rod 14 into a non-represented cutting position in which it cooperates with a lower blade, which is also not shown.

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10 For accomplishing this adjusting movement, a chamber 19 with a pneumatic connector 21 is arranged within the blade head housing 18. The ~~lowering~~ <sup>advancing</sup> piston rod 14 penetrates the chamber 19, and a diaphragm 20 is arranged on the ~~lowering~~ <sup>advancing</sup> piston rod 14 whereby the diaphragm acts as the advancing piston. The diaphragm 20 rests sealingly with its outer periphery against the corresponding inner wall of the chamber 19 within the blade head housing 18. The blade head housing 18 has a recess 22 adjacent to the chamber 19 in the direction of the blade ~~support~~ <sup>holding member</sup> 15 in which cutout a spring 23 is arranged. The spring 23 is supported with one end at the blade head housing 18 and with the other end at the projection 29 of the advancing piston rod 14 so that the advancing piston rod 14 in the ready position shown in the drawing prestresses the circular blade 16.

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The end of the pressure <sup>SP</sup> spring 23 resting at the projection 29 is engaged by a slide 24 with a projection 25, penetrating through an opening 26 into the blade head housing 18. The slide 24 is displaceable externally to the blade head housing 18. The slide 24 has the function of a pressing device for the pressure spring 23 because a pneumatic drive 27 with a pneumatic connector 28 is arranged at the end of the slide 24 which is facing away from the pressure spring 23. When loaded accordingly by compressed air, the <sup>piston 27a of</sup> slide 24 is moved in the direction of the cutting position of the circular blade <sup>16</sup> 26 while at the same time the pressure spring 23 is compressed completely to a "block". The movement of the slide 24 is possible because of the projection 25 being positioned with respective play in the receiving opening 26 in the blade head housing 18.

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When the circular blade 16 of the blade holder shown in the drawing is to be moved into the cutting position, first via the pneumatic connector 28 the pneumatic drive 27 is activated which moves the slide 24 in the direction <sup>of</sup> onto the circular blade 16 so that the pressure spring 23 is completely <sup>compressed</sup> tensioned. Since the slide 24 is decoupled from the advancing piston rod 14 and upon compression of the pressure spring 23 is lifted from the projection

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29 of the advancing piston<sup>rod</sup> 14, the advancing piston rod 14 will first remain in the represented position. By loading the diaphragm 20 via the correlated pneumatic connector 21, it is now possible with correspondingly reduced drive pressure to move in a finely adjusted manner the drive piston rod 14 in the direction of the cutting position of the circular blade until the circular blade 16 will come to rest at the correlated lower blade with the desired cutting force. When it is desired to return the circular blade 16 after completion of the cutting process into its ready position, the pneumatic drive 27 is first switched to be pressure-free and the block-compressed pressure spring 23 then forces, by engaging the projection 29, the lowering piston rod 14 into the position represented in the drawing.

The cutting force control is further improved in that a pressure sensor 30 is arranged which exactly measures the cutting force acting at the circular blade 16, respectively, at the lower blade.

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Between the diaphragm 20 and the blade<sup>holding member</sup> holder 15 a damping member 31 is arranged between the pressure sensor 30 and the shaft projection 29. It is, for example, in the form of an additional spring in order to dampen impact on the membrane resulting from the circular blade 16 so that the precision of the cutting force control is not impaired.

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In Fig. 2, a constructively changed embodiment of the inventive object shown in Fig. 1 is represented in which the slide which forms the pressing device is embodied as a piston 35 positioned in the interior of the blade head housing 18. In comparison to the blade holder represented in Fig. 1, it should be noted that in this embodiment according to Fig. 2 the cutting edge of the circular blade 16 is arranged at the inner side facing the housing 18 so that the circular blade 16 shown in the ready position in Fig. 2 must be moved to the right into its cutting position.

10 In the interior of the blade head housing 18, the chamber 19 has coordinated therewith the pneumatic connector 21 for advancing the circular blade 16, whereby the diaphragm is embodied as a rolling membrane 36 and is connected at the inner side of the blade head housing 18 and, on the other hand, to the shaft projection 29 so that a loading of the pneumatic connector 21 results in a movement of the advancing piston rod 14 to the right.

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20 For embodying the pressing device, in the interior of the blade head housing 18 a partition 37 is provided which separates a chamber 38 in which a piston 35 can be moved to the right under the effect of the pneumatic drive 27. The piston 35 penetrates with its projection 39 the partition 37 and rests in the ready position of

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the circular blade <sup>16</sup>15 with its rear against the shaft projection <sup>39</sup>29.  
One end of the provided pressure spring <sup>23</sup>23 is supported at the  
partition 37 and the other end is connected by a screw 40 to the end  
face of the projection 39 of the <sup>slide</sup>piston 35. Accordingly, the pressure  
spring 23 forces the <sup>slide</sup>piston 35 respectively to the left so that the  
piston 35, by abutting the shaft projection <sup>39</sup>29, also tensions the  
advancing piston rod 14 into the ready position.

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During cutting operation, the pneumatic drive 27 is actuated  
so that the <sup>slide</sup>piston 35 is moved to the right in the chamber 38 and the  
pressure spring 23 is compressed against the partition 37.  
Accordingly, the pressure spring 23 frees the path for an advancing  
movement of the advancing piston rod 14, without requiring  
overcoming the spring force, by loading the chamber 19,  
respectively, the rolling diaphragm 36.

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The disclosed features of the object of these documents  
disclosed in the above description, the claims, the abstract, and the  
drawing, can be essential, individually as well as in any suitable  
combination with one another, for realizing the invention in its  
different embodiments.